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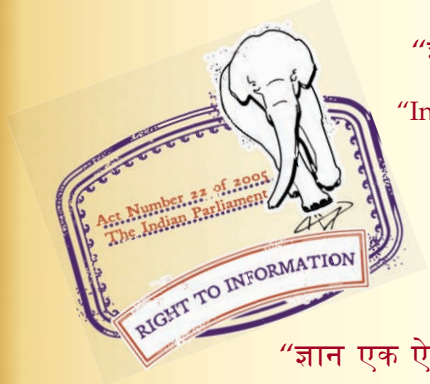
IS 3651-1 (1982): Vernier Calipers, Part I: Vernier Calipers with Least Count 0.1 mm and 0.05 mm [PGD 25: Engineering Metrology]



"ज्ञान से एक नये भारत का निर्माण"
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"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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(Including Amendment No. 1 & 2)

IS : 3651 (Part 1) - 1982
(Reaffirmed 2005)

Indian Standard

SPECIFICATION FOR VERNIER CALIPERS

Part 1 VERNIER CALIPERS WITH LEAST COUNT 0.1 mm AND 0.05 mm)

(Second Revision)

1. Scope — Specifies dimensional, functional and quality characteristics of vernier calipers with least count 0·1 mm and 0·05 mm with a maximum measuring range of 1 000 mm. Methods of testing the accuracy of the instruments are given in the Appendix A for general information only.

Note — These vernier calipers are also commonly known as 1/10 and 1/20 vernier calipers respectively.

2. Types

2.1 *Type A* — With jaws on both sides for external and internal measurements and with a blade for depth measurement (optional) (*see* Fig. 1).

2.2 *Type B* — With jaws on one side for external and internal measurement (*see* Fig. 2).

Note — Type B vernier caliper may be provided with fine adjustment mechanism.

3. Nomenclature

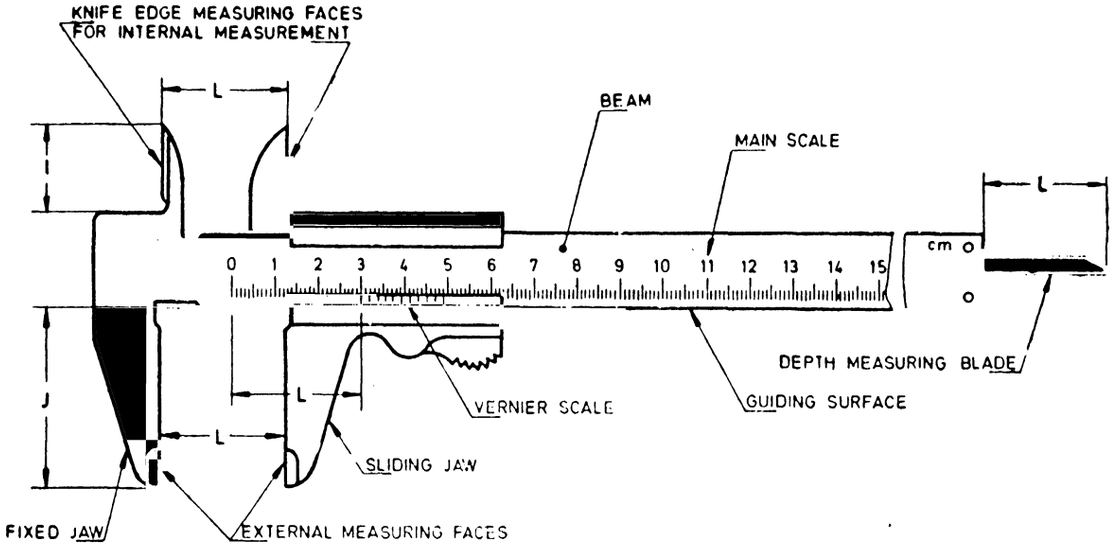

FIG. 1 NOMENCLATURE AND DIMENSIONS FOR TYPE A VERNIER CALIPERS

4. Definitions — For the purpose of this specification, following definitions shall apply

4.1 *Error of Measurement* — The algebraic difference between the measured size and the true size.

4.2 *Measuring Uncertainty* — The error margin corresponding to the inherent errors of measurement of a vernier caliper. It is defined as being equal to ± 2 s, that is for a normal distribution of the readings on the instrument, about 95 percent of reading will not deviate from the mean size (true value) by more than twice the standard deviations.

5. Material — The main parts of vernier caliper, such as beam, sliding, jaw and depth measuring blade shall be made of good quality steel (plain carbon steel or stainless steel).

6. Hardness — The measuring faces shall be hardened to 700 HV *Min* for plain carbon steel and 550 HV *Min* for stainless steel.

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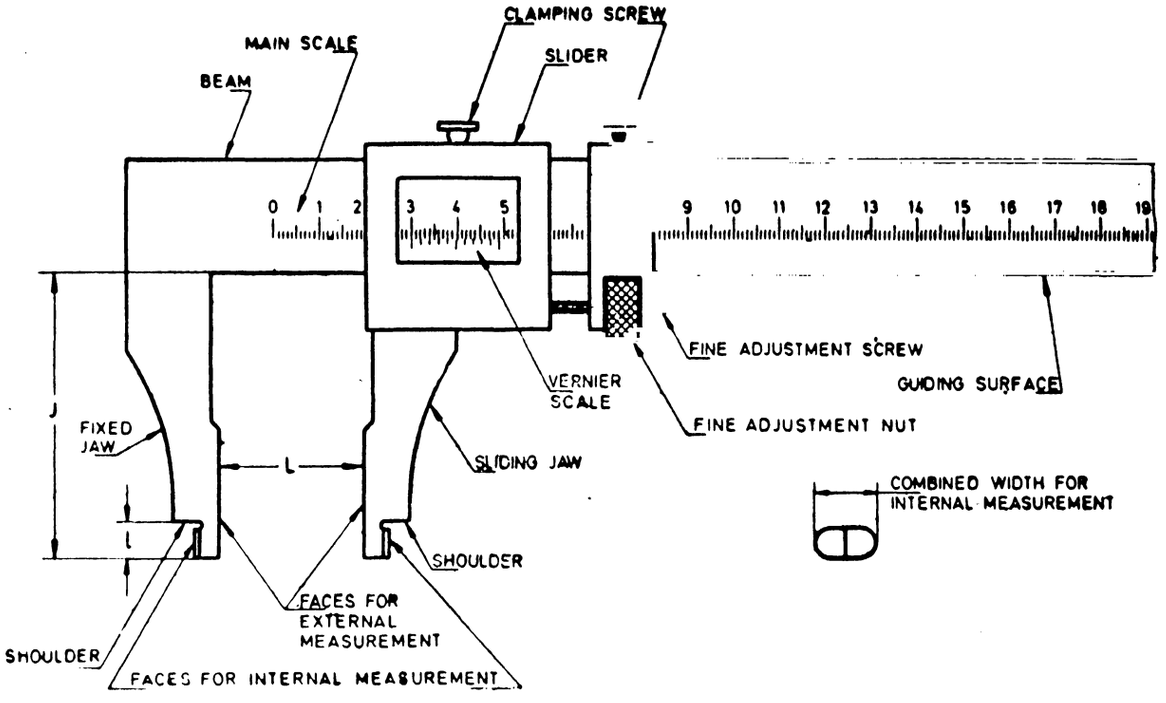

FIG. 2 NOMENCLATURE AND DIMENSIONS FOR TYPE B VERNIER CALIPERS

6.1 The measuring face of depth measuring blade shall be hardened to 475 HV *Min.*

7. Dimensions

TABLE 1 DIMENSIONS OF VERNIER CALIPERS

(*Clauses* 7, 8.2.1, 8.2.3 *and* Fig. 1 and 2)

All dimensions in millimetres.

External Measuring Range	Minimum Projections of Jaws, *J, Min*	Minimum Length of faces for Internal Measurement, *L Min*
0 to 135	35	6
0 " 160	40	6
0 " 200	50	8
0 " 250	50	10
0 " 300	60	10
0 " 500	80	15
0 " 750	80	15
0 " 1 000	100	20

7.1 It is recommended that Type A verniers should not be used for measuring range more than 0-300 mm

8. General Requirements

8.1 *Beam* — The beam shall be long enough for the sliding jaw assembly not to overhang when measuring at the end of the measuring range.

8.2 *Jaws*

8.2.1 For minimum projection of the jaws, *J Min* (*see* Table 1).

8.2.2 The maximum projection, *J Max* shall be equal to one-third of the measuring range but with a maximum of 200 mm. The sliding jaw shall be a good sliding fit along the beam in order to permit fine adjustment to be made The slider shall be provided with a suitable clamp so that it may be effectively clamped to the beam without altering the setting.

AMENDMENT NO. 1 NOVEMBER 1985

TO

IS:3651(Part 1)-1982 SPECIFICATION FOR VERNIER CALIPERS

PART 1 VERNIER CALIPERS WITH LEAST COUNT 0.1 mm AND 0.05 mm

(Second Revision)

(*Page 5*) - Transfer the following matter from its present position and add it after first paragraph of Explanatory Note:

"The main modifications are:

a) 0.02 mm accuracy has been deleted in view of proposed separate ISO standard for the said accuracy and the standard is numbered as Part 1.

b) Type C vernier caliper deleted.

c) The hardness of depth measuring blade retained which was based on GOST: 166-63 'Vernier calipers'.

d) Considering the present manufacturing practice, a separate clause has been incorporated to specify the dimension of Type A vernier caliper.

e) The range has been restricted to 1 000 mm in line with ISO 3599-1976.

f) Vernier scale with 39 mm length deleted to avoid ambiguity."

(EDC 43)

AMENDMENT NO. 2 AUGUST 1991

TO

IS 3651 (Part 1) : 1982 SPECIFICATION FOR VERNIER CALIPERS

Part 1 VERNIER CALIPERS WITH LEAST COUNT 0.1 mm AND 0.05 mm)

(Second Revision)

(Page **1**, clause **6**) — Substitute the following for the existing clause :

'**6 Hardness** — The hardness shall be:

a) for the beam, 350 HV, *Min*

b) for the measuring faces of the jaws:

- made of carbon steel, 700 HV, *Min*
- made of stainless steel, 550 HV, *Min*

c) for the measuring face of depth measuring blade, 45 HV, *Min*'

(LMD 05)

8.2.3 For the minimum length of the faces (*L, Min*) for internal measurement (*see* Table 1).

8.2.4 The jaws may be provided with knife edges as shown in Fig. 1.

8.2.5 The nominal combined width of the jaws for internal measurement shall be 0 (for jaws with knife edges), 5, 10 or 20 mm. The faces for the internal measurement (except the knife-edge faces) shall be of cylindrical form with a radius not exceeding one-half of their combined width (*see* Fig. 2).

8.3 *Depth Measuring Device* — The vernier caliper may be provided with a depth measuring blade which isconnected to the slider and allows the measurement of depths with reference to the end face of the beam (*see* Fig. 1).

8.4 *Scales*

8.4.1 The beam shall be graduated in millimetres and the length of the scale shall be at least equal to the measuring range of the caliper plus the length of the vernier.

8.4.2 The scale lines of both the beam and the vernier shall be sharp, clear and perpendicular to the edge of the beam.

8.4.3 The length of the vernier scale may be 9 and 19 mm for 0·1 mm and 0·05 mm least count respectively (*see* Fig. 3A and 3B).

8.4.4 The thickness of the scale lines shall not be less than 0·08 mm and not more than 0·2 mm.

8.5 *Graduations*

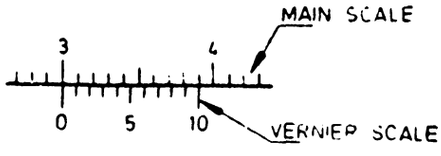

FIG 3A 0·1 VERNIER OF LENGTH 9 mm

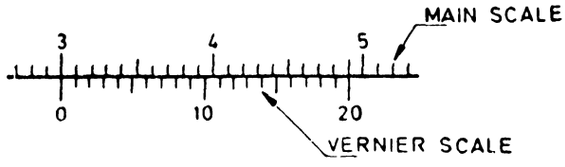

FIG. 3B 0·05 VERNIER OF LENGTH 19 mm

8.5.1 The numbering on the beam and the vernier shall be such that the scale is easy to read.

8.5.2 The distance between the graudated face of the beam and the edge of the graduated, levelled face of the vernier shall not exceed 0·3 mm (*see* Fig. 4).

8.5.3 To facilitate reading, the surface of the beam and the vernier may be given a matt finish and the graduation lines filled with black pigment.

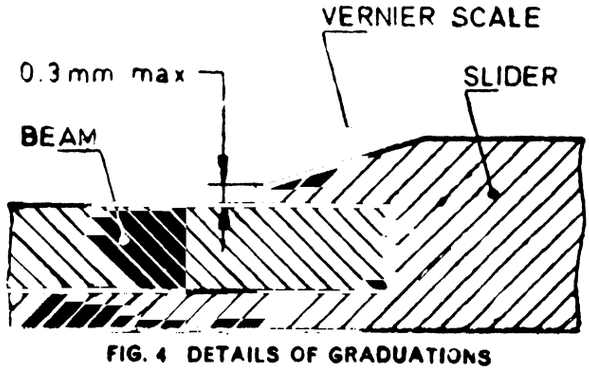

FIG. 4 DETAILS OF GRADUATIONS

9. Accuracy

9.1 *Measuring Uncertainty* — The permissible measuring uncertainty in micrometres at ± 2 s, as given in Table 2, is calculated from the following :

$$\pm (50 \pm 0{\cdot}1\ l)$$

Where l is any measured length, in millimetres, within the measuring range.

9.2 *Measuring Faces* — With the slider clamped to the beam at any position within the measuring range of the caliper, faces for external measurement shall be flat to within 10 μm per 100 mm over their length. They shall be parallel to within 20 μm per 100 mm over their length.

9.2.1 The faces for internal measurement shall be parallel to within 10 μm over their length and the permissible tolerance for their combined width (*see* 8.2.5) shall be $^{+30}_{0}$ μm.

TABLE 2 MEASURING UNCERTAINTY

Measured Length l	Measuring Uncertainty at ± 2 s (95 percent)
mm	μm
0	± 50
100	± 60
200	± 70
300	± 80
400	± 90
500	± 100
600	± 110
700	± 120
800	± 130
900	± 140
1 000	± 150

9.3 *Scale Lines* — The thickness of all scale lines on the main scale and vernier shall not differ by more than 0·03 mm.

10. Designation — The vernier caliper shall be designated by the type, nominal size, least count, the material used and number of this standard.

Examples :

i) A vernier caliper of Type A with normal size 300 mm, least count 0·1 mm and made of stainless steel shall be designated as :

Vernier Caliper A—300-0·1 Stainless Steel IS : 3651

ii) A vernier caliper with normal size 300 mm, least count 0·1 mm and made of stainless steel with depth measuring blade shall be designated as :

Vernier Caliper A 300-0·1 Stainless Steel IS : 3651 with depth measuring blade

iii) A vernier caliper of type B with normal size 300 mm, least count 0·05 mm and made of plain carbon steel and with fine adjustment may be designated as:

Vernier Caliper B 300-0·05 Steel IS : 3651 with fine adjustment

11. Marking — Each caliper shall have legibly and permanently marked upon it, in characters not less than 1 mm high, the nominal size of the caliper, the least count and manufacturer's name or trade-mark, if any.

11.1 *Certification Marking* — Details available with the Bureau of Indian Standards.

12. Packing — Each vernier shall be coated with suitable anticorrosive coating and shall be wrapped in a moisture-proof paper or any other suitable wrapping material. Wrapped vernier caliper shall be packed in a suitable protective case.

GMGIPN—33 BIS/ND/07—100

The main modifications are:

(a) 0·02 mm accuracy has been deleted in view of proposed separate ISO standard for the said accuracy and the standard is numbered as Part I.

(b) Type C vernier caliper deleted.

(c) The hardness of depth measuring blade retained which was based on GOST: 166-63, ' Vernier calipers '.

(d) Considering the present manufacturing practice, a separate clause has been incorporated to specify the dimension of Type A vernier caliper.

(e) The range has been restricted to 1 000 mm in line with ISO 3599-1976.

(f) Vernier scale with 39 mm length deleted to avoid ambiguity.

APPENDIX A

METHODS OF TEST

A-1. Measuring Uncertainty — The inherent errors of measurement of a vernier caliper may be checked with gauge block combinations of known size chosen to cover a number of points both over the range of the instrument and that of the vernier.

A-1.1 The measuring faces of the gauge blocks shall be placed between the jaws, and the outside measuring faces of the caliper shall be checked at three points.

A-2. Measuring Faces

A-2.1 *Flatness* — The flatness of the faces for external measurements may be checked by applying a knife edge, straight edge, or by another appropriate method.

A-2.2 *Parallelism* — The parallelism of the faces for external measurement may be checked by inserting gauge blocks between them at different points of the jaws and at different measured lengths by varying the sizes of the gauge blocks.

A-2.2.1 The parallelism of the faces for external measurements shall not be affected by clamping the slider. This may be checked by leaving a narrow gap between the measuring faces and observing this gap when clamping the slider.

A-2.2.2 The parallelism of the faces for internal measurement may be checked by means of a micrometer. To ensure that the radius is not too large, the combined jaws may be checked with a plain ring gauge of 5, 10 and 20 mm diameter as applicable.

A-2.3 *Scale Lines* — The thickness of scale lines may be checked by direct measurement with a microscope fitted with a micrometric device.

EXPLANTORY NOTE

This standard was originally published in 1966 and subsequently revised in 1974. The Committee responsible for the standard decided to revise it on the basis of further experience gained in the manufacture and also to make it in line with ISO 3599-1976 ' Vernier calipers reading to 0·1 mm and 0·05 mm '.

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